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STUDIES IN CEREAL DISEASES

V

CONTROL METHODS FOR DISEASES OF CEREAL, FORAGE, AND FIBRE CROPS

PREPARED BY

THE DOMINION LABORATORIES OF PLANT PATHOLOGY
AT WINNIPEG, SASKATOON, AND EDMONTON

DIVISION OF BOTANY
DOMINION EXPERIMENTAL FARMS

H. T. GÜSSOW, DOMINION BOTANIST

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CONTROL METHODS FOR DISEASES OF CEREAL FORAGE, AND FIBRE CROPS

Prepared by the Dominion Laboratories of Plant Pathology at Winnipeg, Saskatoon and Edmonton

This circular is an attempt to give briefly a summary of our present knowledge of control methods. Besides the specific recommendations found under each disease, certain general rules must be kept in mind.

Exclusion.—There is always the possibility of some new disease being introduced into the country in spite of quarantine laws. Growers should report any diseased condition with which they are unfamiliar, so that the necessary steps can be taken to investigate the situation. Seeds from foreign countries should be properly treated and the plants watched for the appearance of disease.

Eradication.—If some serious disease appears in a small area, it might be practicable to destroy every affected plant and thus stamp out the trouble. The eradication of alternate hosts is often advantageous, as in the case of the common barberry to lessen the possibility of a stem rust epidemic.

Seed Selection.—Wheat, barley, oats, flax, and other seed should be graded wherever feasible, so as to eliminate light-weight, shrivelled seed. Only plump, sound seed should be sown. Seed grain, especially, should be selected from disease-free fields. A small seed plot can be given special attention in cultivation, harvesting, and frequent examination to ensure the best possible seed.

Seed Treatment.—Seed treatments by means of chemicals are now well-established methods, and sufficient examples will be found in the following pages.

Dusting and Spraying.—The use of chemical dusts and sprays applied to the growing plants is essential in many cases to protect crops from diseases.

Cultural Methods.—The destruction of weeds, which may propagate disease-producing organisms as well as compete for plant food, is an essential factor in crop treatment. Crop rotation is probably the most important cultural factor. Any causal organism, particularly one which can live on debris and in the soil, would tend to increase if the land is repeatedly sown to its host. By the use of summer-fallow or uncongenial crops, the foothold of such an organism should be weakened. To make crop rotation effective in controlling a disease, one must know the disease under consideration, its life history, and the hosts which it attacks.

SANITATION.—Crop refuse may harbour disease-producing organisms, so every effort should be made to destroy such debris after a field has shown disease. Deep ploughing, to bury such material, is advisable. The practicability of sanitation is largely dependent upon the disease in question.

DISEASE-RESISTANT VARIETIES.—It is often possible to use a variety of a crop which is resistant to a particular disease and so obtain complete protection. The work of plant breeders may bring about a wider use for this method of control.

WHEAT

Stem Rust, *Puccinia graminis Pers.* var. *Tritici* Erikss. & Henn.

Dark-red spots or pustules, about one-eighth of an inch long, on stems (occasionally on leaves and glumes) of the green plant. Pustules rupture epidermis of plant and produce masses of reddish spores. Pustules become dark-brown or black on ripe grain, owing to formation of black winter spores. Heavily rusted grain has brittle straw and produces small shrivelled seed. Of major importance.

CONTROL.—Early sowing; dusting standing crop with sulphur; sowing resistant varieties in worst rust areas; eradication of barberry (wherever present). (See Bulletin No. 106.)*

Leaf Rust, *Puccinia triticina* Erikss.

Small orange-coloured rounded pustules on leaves and sheaths (occasionally on glumes). Black winter spores are produced, as in stem rust, but the round black pustules are covered by the epidermis. It usually appears earlier than stem rust, but is less destructive. Of major importance.

CONTROL.—Dusting standing crop with sulphur. Resistant varieties suitable for Western Canada are not available. (See Bulletin No. 106.)

Stripe Rust, *Puccinia glumarum* (Schm.) Erikss. & Henn.

Oblong orange-yellow pustules arranged in long lines on leaves, sheaths, and glumes. Pustules of black winter spores covered by epidermis. Occurs in Alberta and British Columbia. Up to the present this rust has been relatively unimportant.

CONTROL.—Resistant varieties suitable for Western Canada are not available. (See Bulletin No. 106.)

Bunt of Wheat, *Tilletia Caries* (DC.) Tul. and *T. foetens* (Berk. & Curt.) Tul.

Infected kernels, at maturity, filled with blackish-brown spores which have an odour of herring brine. Of major importance.

CONTROL.—Remove all bunt balls and treat seed with formalin solution (1-320) by the "dip" or "sprinkle" method for durum wheat. Copper carbonate dust at the rate of 2 ounces per bushel of seed may be used for common wheat. (See Bulletin No. 81.)

* Publications referred to are of the Canadian Department of Agriculture and may be obtained, upon request, from the Publications Branch, Department of Agriculture, Ottawa.

Loose Smut of Wheat, *Ustilago Tritici* (Pers.) Jens.

Heads completely converted into masses of black spores which are soon carried off by the wind, leaving only the empty rachis. Frequently of major importance.

CONTROL.—Place grain in loosely woven sacks, half a bushel to each sack, and tie the sacks at the top so as to leave plenty of room for the grain to swell. Soak for four hours in water at room temperature; dip for two minutes in water at a temperature of about 120°F.; and then place for ten minutes in water kept at 129°F. Spread out the grain to dry, and seed as soon as it will run through the drill. Careful removal of smutty heads from the seed plot, as they appear, will also help to control this disease. (See Bulletin No. 81.)

Black Chaff, *Pseudomonas translucens* J. J. & R. var. *undulosa* J. J. & R.

A bacterial disease showing yellow translucent to brown spots scattered on leaves and dark brown to black streaks on "neck" and outer glumes. The kernels are often badly shrivelled. May become of major importance.

CONTROL.—This is a seed-borne disease. Use only disease free seed. The ordinary seed treatments as used for smut control are in all probability helpful.

Basal glume rot, *Pseudomonas atrofaciens* (McCull.) Stev.

A bacterial disease quite distinct from black chaff. A characteristic feature is the dark brownish-black area at the base of the glumes. Affected kernels show a distinct charcoal black area at the germ end. The leaves are also attacked but no very distinctive symptoms are shown. Of minor importance.

CONTROL.—Apply the same methods as suggested under "Black Chaff".

Scab or Head Blight, *Fusarium spp.*

The entire head or any part of it may be attacked. The affected areas turn pale and are readily noticed while the head is green. In severe cases a pinkish fungous growth will cover the affected part. The kernels from diseased heads are light, shrunken, and usually of a dull greyish colour. May become of major importance.

CONTROL.—Clean the seed thoroughly so as to get rid of light or discoloured kernels. Treating the seed with Semesan 0·6 per cent solution is recommended.

Ergot, *Claviceps purpurea* (Fr.) Tul.

Of minor importance on this host.

See Rye.

(See Circular No. 69.)

Glume Blotch, *Septoria nodorum* Berk.

Brown or greyish blotches on the glumes, usually starting at the top. Kernels may be shrivelled. Of minor importance.

CONTROL.—No adequate control measures known.

Head Blight, *Helminthosporium sativum* Pamm. King & Bakke.

Dark brown areas on the glumes or over entire spikelet. Kernels are discoloured, having a smudgy appearance. May become of major importance.

CONTROL.—Use only clean seed, and avoid samples containing many discoloured kernels.

Powdery Mildew, *Erysiphe graminis* DC.

Superficial, fluffy, greyish-white patches appear on the leaves; later small spherical black bodies, the perithecia, form within these patches. Of minor importance.

CONTROL.—No adequate control measures known.

Leafspots, *Septoria Tritici* Desm.; *Septoria nodorum* Berk.; *Helminthosporium sativum* P.K. & B.; and bacteria.

Of minor importance.

CONTROL.—No control measures known.

Root-Rot. Take-all, *Ophiobolus graminis Sacc.*

Occurs in patches or on single plants scattered throughout the field. At heading time affected plants are short and bleached. The heads contain shrunken kernels. The base of the stalks and root system are dark brown or black. Of major importance.

CONTROL.—(1) When take-all has been noticed in the first wheat crop after breaking, avoid sowing wheat the second year. Oats or some other crop which is not attacked by this disease may be sown, or the field summer-fallowed, before cropping again to wheat.

(2) In districts where take-all is prevalent avoid sowing wheat for more than two years in succession on older land.

(3) Do not sow wheat as the first crop following western rye or brome grass if take-all is prevalent.

(4) Oats, flax, sweet clover, sunflowers, and potatoes are not attacked by this disease; if this is kept in mind rotations may be modified accordingly.

(See Circular No. 72 and Pamphlet No. 85).

Root-Rots, *Helminthosporium sativum* Pamm. King & Bakke; and *Fusarium spp.*

Root-rots should be suspected when plants bleach prematurely, show distinct dark lesions on the base of the stalks or are late in maturing. Severe blighting of seedlings is further evidence of root disease. Of major importance.

CONTROL.—(1) The very best seed obtainable should be used.

(2) Seed samples containing many shrivelled or discolored grains must be avoided, as there is a possibility of introducing root-rotting fungi into the soil by the use of such seed.

(3) As a general rule most of the cereals should be sown as early as convenient, unless the field is infested with wire-worms.

(4) Deep seeding is harmful, a depth not greater than two or three inches is advisable.

(5) Rotations and cultural practices should be carefully studied on farms where these diseases occur.

(See Circular No. 72 and Bulletin No. 85).

OATS

Stem Rust, *Puccinia graminis* Pers. var. *Avenae* Erikss. & Henn.

Like stem rust of wheat.

CONTROL.—Same as for stem rust of wheat. (See Bulletin No. 106).

Crown Rust, *Puccinia coronata* Corda.

Elongated orange-coloured pustules on leaves and sheaths. Black pustules of winter spores in rather long raised streaks under epidermis. Usually found in vicinity of buckthorn hedges. Often of major importance.

CONTROL.—Eradication of buckthorn; dusting standing crop with sulphur. (See Bulletin No. 106).

Covered Smut of Oats, *Ustilago levis* (Kellerm. & Swingle) Magn.

Panicles converted into masses of blackish-brown spores which are loosely enclosed by the remains of the outer glumes. Of major importance.

CONTROL.—(1) Hulled oats: Apply the formalin "spray" treatment (1-1) at the rate of 1 quart of solution to 50 bushels of seed; or the formalin "sprinkle" treatment (1-320) at the rate of 1 gallon of solution per bushel of seed. (2) Hulless Oats: Treat with copper carbonate dust at the rate of 4 ounces per bushel of seed. (See Bulletin No. 81).

Loose Smut of Oats, *Ustilago Avenae* (Pers.) Jens.

Panicles converted into naked masses of blackish-brown spores. Of major importance.

CONTROL.—Treat as for covered smut of oats. (See Bulletin No. 81).

Halo Blight, *Pseudomonas coronofaciens* (Ch. Elliott) Stev.

Scattered oval or irregular blotches of various sizes on leaves and on spikelets. Centres of blotches dead and collapsed, margins turgid and yellow-green in colour. Of minor importance.

CONTROL.—Ordinary seed treatments reduce, but do not fully control the seed-borne infections.

Head blight or scab, *Fusarium* spp.

Of minor importance so far in Western Canada.
(See under wheat).

Anthracnose, *Colletotrichum graminicolum* (Ces.) Wils.

Affects heads, culms, and leaves, producing areas showing tiny black dots. Of minor importance.

CONTROL.—No definite control measures known. Clean seed, and ordinary seed treatments should help.

Leaf spot blotch, *Leptosphaeria avenaria* Weber.

Spotted blotches appear on the leaves. Of minor importance.

CONTROL.—No control measures known.

Leaf discoloration, *Helminthosporium* sp.

Causing dark spots and general discoloration of the leaves. Of minor importance.

CONTROL.—No control measures known.

Ergot, *Claviceps purpurea* (Fr.) Tul.

Rare on oats. Of minor importance.

CONTROL.—See rye. (See Circular No. 69).

Blast (Physiological).

Panicles fail to set seed. White sterile spikelets are conspicuous. Of major importance.

CONTROL.—No definite control measures known.

Root-Rots, *Fusarium* spp.

Of major importance.

CONTROL.—Note general recommendations under root-rot of wheat. (See Circular No. 72 and Bulletin No. 105).

BARLEY

Stem Rust, *Puccinia graminis* Pers.

Identical with stem rust of wheat.

CONTROL.—Early sowing advisable. Usually barley ripens early and escapes severe damage. Eradication of barberry (wherever present). (See Bulletin No. 106).

Leaf Rust, *Puccinia anomala Rostr.*

Very small reddish-brown pustules scattered over leaves. Black pustules of winter spores covered by epidermis. Of little importance in Western Canada.

CONTROL.—Control measures not worked out. (See Bulletin No. 106).

Covered Smut of Barley, *Ustilago Hordei* (Pers.) Kellerm. & Swingle

Affected heads are greyish in colour due to the presence of a delicate white membrane surrounding the spore masses. Of major importance.

CONTROL.—Remove all smut balls and apply the formalin "sprinkle" treatment (1-320) at the rate of 1 gallon of solution per bushel of seed. (See Bulletin No. 81).

Loose Smut of Barley, *Ustilago nuda* (Jens.) Rostr.

Affected heads completely converted into dusty masses of spores which are dispersed by the wind, leaving only the empty rachis. Usually of minor importance.

CONTROL.—As for loose smut of wheat, except that the temperature of the treating bath should be kept at 128° F.

Barley stripe, *Helminthosporium gramineum* Rabh.

Leaves with one or more long yellowish stripes with brownish margins. The diseased area frequently shreds. Diseased plants are often stunted and distorted, and the heads commonly fail to emerge from the sheath, in which case the plant is a total loss. Often of major importance.

CONTROL.—Sow good clean seed, preferably from disease-free fields. Soak seed for one hour in a 0.3 per cent solution of Semesan.

Net Blotch, *Pyrenophora teres* (Died.) Drechsl. (*Helminthosporium teres* Sacc.)

Localized, slightly netted brown blotches irregularly distributed on some or all leaves. Badly attacked leaves die and bleach. The grain matures with some shrinkage when the disease is very severe. Usually of minor importance.

CONTROL.—Ordinary seed treatments should reduce this disease.

Spot Blotch, *Helminthosporium sativum* Pamm. King & Bakke.

Spots most conspicuous on leaves, but may occur on head and stem. The blotches are irregular, and commonly merge into large areas which are usually brown with darker brown margins. Usually of minor importance.

CONTROL.—No satisfactoy control is yet available. Sow clean bright seed and practice crop rotation.

Leaf Blotch, *Septoria Passerinii* Sacc.

Yellowish to brown spots occur singly or merged on the leaf. Of minor importance.

CONTROL.—Crop rotation.

Scald Spot, *Rhynchosporium secalis* (Oud.) Davis

Rather large, irregular, variously scattered blotches occur chiefly on blades and sheaths, which they kill. Blotches vary greatly in colour from greenish-blue to ashen gray; commonly chocolate brown at margins in advanced stages. Of minor importance.

CONTROL.—No definite control measures known.

Bacterial Blight, *Pseudomonas translucens* Jones, Johns. & Reddy

Translucent spots or stripes on leaves, becoming light brown. Bacterial exudate sometimes evident. Of minor importance.

CONTROL.—No feasible control.

Seed Discoloration, *Helminthosporium sativum* Pamm. King & Bakke

Various degrees of seed discoloration occur, especially in wet seasons. This disease is most frequently caused by *Helminthosporium sativum*, although other fungi and bacteria may be associated. Often of major importance.

CONTROL.—Sow clean seed and practice crop rotation. See net blotch of barley.

Ergot, *Claviceps purpurea* (Fr.) Tul.

Usually of minor importance in this crop.

CONTROL.—See rye.

Powdery Mildew, *Erysiphe graminis* DC.

Of minor importance.

CONTROL.—See wheat.

RYE

Stem Rust, *Puccinia graminis* Pers. var *Secalis* Erikss. & Henn.

Like stem rust of wheat.

CONTROL.—Dusting standing crop with sulphur; eradication of barberry (wherever present). Resistant varieties suitable for Western Canada not available.

Leaf Rust, *Puccinia dispersa* Erikss.

Resembles leaf rust of wheat, but the pustules are chocolate brown in colour. Chiefly on leaves. Pustules of black winter spores covered by epidermis. Commonly found on rye, but of minor importance.

CONTROL.—Resistant varieties suitable for Western Canada are not available. (See Bulletin No. 106).

Stem Smut of Rye, *Urocystis occulta* (Wallr.) Rabh.

Long parallel black streaks appear on the leaves, leaf-sheaths, and stems of affected plants. Of minor importance in Western Canada.

Control.—Crop rotation; treatment of seed by the formalin "sprinkle" method at the rate of 1 gallon of solution per bushel of seed.

Ergot, *Claviceps purpurea* (Fr.) Tul.

Large black bodies called sclerotia develop on the heads and are seen protruding from between the glumes. These sclerotia are commonly found in the threshed grain. Of major importance.

Control.—The ergot bodies should be separated from the seed. Complete separation is possible only by immersing the grain in a solution of common salt, made up by dissolving 40 pounds of salt in 25 gallons of water. Stirring the grain brings the ergot bodies to the surface, where they can be skimmed off and destroyed. The grain is then washed at once with water and dried quickly to prevent injury to germination. A succession of crops susceptible to ergot should be avoided as far as possible. Durum wheats are more susceptible than the common wheats. Brome, western rye, and other wild wheat and rye grasses, which are commonly found about the borders of fields, are also attacked by the Ergot fungus. Cutting these grasses before they flower should eliminate this source of infection. Deep ploughing after a badly infested crop is recommended, in order to bury the ergot bodies which have fallen to the ground during harvest. (See Circular No. 69).

Powdery Mildew, *Erysiphe graminis* DC.

Of minor importance.

(See same disease under wheat).

Head Blight, *Fusarium* spp.

Of minor importance.

(See same disease under wheat).

Root Rot, *Fusarium* spp.

Of major importance.

Control.—Note general recommendation under root-rot of wheat. (See Circular No. 72).

CORN

Corn Rust, *Puccinia Sorghi* Schw.

Reddish-brown pustules on leaves. Pustules of black winter spores covered by epidermis. Of little importance in Western Canada.

Control.—Control measures not worked out.

Corn Smut, *Ustilago Zeae* (Beck.) Unger

Galls appear on the leaves, stems, or inflorescences of the affected plants. At maturity the larger galls may break open exposing the spore masses. May become of major importance.

CONTROL.—Crop rotation and the growing of resistant varieties. Pick all smut galls in paper bags and burn, if practicable.

Root Rot, *Fusarium* spp.

Most conspicuous as a seedling blight and stalk rot of young plants. May become of major importance.

CONTROL.—Plant corn as late as possible to gain the advantage of warm soil conditions. Seed should only be selected from ears which have been kept in a dry place and are free from moulds.

MILLET

Smut of Fox-Tail Millets, *Ustilago Crameri* Koern.

Affected heads dark in appearance. Spores either naked or enclosed in a membrane.

CONTROL.—Apply the formalin "sprinkle" treatment, using 1 gallon of solution per bushel of seed, and cover for 2 hours before seeding.

Smut of Broom Millets, *Sorosporium Panici-miliacei* (Pers.) Taka.

Panicle completely destroyed, its place being taken by an elongated gall filled with spores.

CONTROL.—Formalin treatment as for smut of fox-tail millets.

Downy Mildew, *Sclerospora graminicola* (Sacc.) Schroet.

Heads may be deformed and leaves discoloured. May become of major importance.

CONTROL.—No definite recommendations for Canadian conditions can be given.

FLAX

Flax Rust, *Melampsora Lini* (Pers.) Desm.

Bright orange, rounded pustules on green leaves and stem. Pustules of winter spores at first reddish-brown, later black, covered by epidermis. Of minor importance.

CONTROL.—Resistant varieties (of seed flax); removal of infected straw, and crop rotation recommended.

Wilt, *Fusarium Lini* Bolley

Affected plants wilt at any stage, especially during early growth, as if suffering from drought, and become sickly and yellow. An important disease.

CONTROL.—Use resistant varieties. Write to the nearest Experimental Farm or University for information as to the most suitable variety for the district.

Stem Break, *Polyspora Lini* Laff.

Brown spots occur on leaves, stems, and seed pods, where later they may merge into blotches. Cankers occur at the ground line causing the young plants to break over. Often of major importance.

CONTROL.—Sow cleaned seed from healthy fields. Burn old flax straw and stubble. Crop rotation.

Heat Canker

Death of the tissue is caused by excessively high temperature of the soil at ground line, especially on soils which bake and where the stand of plants is thin. This trouble occurs at any stage, although chiefly during the seedling stage. Often of major importance.

CONTROL.—Seed early. A thin nurse crop of wheat is helpful in certain cases.

SUNFLOWER

Sunflower Rust, *Puccinia Helianthi* Schw.

Brownish rounded pustules on leaves and stocks. Winter spores in dark-brown to black pustules. Heavily rusted leaves curl up and wither. Of minor importance.

CONTROL.—Control measures not worked out. Clean culture and burning of refuse recommended.

Wilt, *Sclerotinia Sclerotiorum* (Lib.) de Bary

The plants are attacked near the soil level and soon wilt. Rather large black sclerotia may be found in or on the affected part. Of minor importance.

CONTROL.—Do not crop infested land to alfalfa, clover, soy-beans or vegetables, as they are susceptible; use instead cereals, corn, or grasses; keep sunflowers off the land for at least two years after the attack.

Downy Mildew, *Plasmopara Halstedii* (Farl.) Berl. & de Toni

Cotyledons, stems, and leaves may be mottled. Of minor importance.

CONTROL.—There is some evidence that the fungus may be carried over in the soil. Rotations are advisable.

Chlorosis (Physiological)

Leaves lose their normal green colour, becoming white. Of minor importance.

CONTROL.—No definite control measures known. It is probably a nutritional trouble.

ALFALFA

Alfalfa Rust, *Uromyces Medicaginis* Pass.

Reddish-brown pustules on under side of leaves. Winter spores in darker pustules. Most common in wet seasons. Usually of minor importance.

CONTROL.—Frequent cutting may help to hold it in check.

Sclerotinia Root-Rot, *Sclerotinia Trifoliorum* Erikss.

Large or small areas of the tap root and laterals may rot at any time, although the rot is usually more pronounced in Western Canada following the winter dormancy period. Look for bits of hard black sclerotial masses of the fungus upon and within the rotted tissue, and the white threads of the fungus about the root. Often of major importance.

CONTROL.—Crop rotation.

Leaf Spot, *Psuedopeziza Medicaginis* (Lib.) Sacc.

Numerous small black to brown, irregular to circular, spots appear upon the leaves and stems. Badly diseased leaves turn yellow and drop off. The plants are never killed by this disease. Usually of minor importance.

CONTROL.—In severe cases the only practicable treatment is to mow the crop early before the leaves are shed.

Yellow Leaf Blotch, *Pyrenopeziza Medicaginis* Fuck.

A common blotch. The spots are deep yellow to orange and are larger than those of leaf spot. Some leaf-drop may occur. Usually of minor importance.

CONTROL.—Early cutting is beneficial in severe cases.

SWEET CLOVER

Sclerotinia Root-Rot, *Sclerotinia Trifoliorum* Erikss.

For symptoms and control, see alfalfa.

Brown Root-Rot, *Plenodomus Meliloti* Dearn. & Sanford

Brown rotted areas occur on the tap root and the lateral roots and may involve the crown. Rotting takes place from late winter to June, when the lesions may heal. This root-rot is characterized by numerous small black fruiting bodies upon and within the rotted tissue. An important disease.

CONTROL.—Control measures have not yet been worked out. Crop rotations.

Stem Canker, *Ascochyta Meliloti* (Trel.) Davis

Characteristically a stem canker. Extensive dark-brown irregular, diseased areas occur on the stems and leaves; later becoming grayish with numerous tiny slightly raised black spore-bodies which contain spores. Severely diseased plants may die.

CONTROL.—Preventive measures have not been devised yet. Cut and burn diseased debris.

COMMON CLOVER

Clover Rusts, *Uromyces* spp.

There are four: *Uromyces Trifolii* (Hedw.f) Lév. on red clover; *U. Trifolii-repentis* Liro and *U. flectens* Lagerh. on white clover; and *U. hybridi* W. H. Davis on alsike clover. All are very similar, forming reddish-brown rounded pustules on the plants in summer, and dark-brown pustules of winter spores late in the season. Of minor importance.

CONTROL.—Control measures not worked out.

Sclerotinia Root-Rot, *Sclerotinia Trifoliorum* Erikss.

For symptoms and control, see alfalfa.

Brown Root-Rot, *Plenodomus Meliloti* Dearn. & Sanford

Similar to brown root-rot of sweet clover.

CONTROL.—See sweet clover.

Powdery Mildew, *Erysiphe Polygoni* DC.

A whitish growth of the fungus occurs on the leaves during the summer months. Lesions do not occur and the damage is not often significant.

CONTROL.—No definite control measures known.

Leaf Spot, *Pseudomonas Trifolii* (Biv.-Bern.) Fuck.

Much like alfalfa leaf spot, but less prevalent.

CONTROL.—See leaf spot of alfalfa.

Sooty Spot, *Dothidella Trifolii* (Pers.) Bayl. Elliott & Stansf.

Occurs on common red clover, crimson clover, white clover, alsike cover, and several related plants. Pale spots appear upon the upper surface of the leaves accompanied by black dots on the lower surface. Of minor importance.

CONTROL.—No treatment is known.

Dominion Rust Research Laboratory,
Manitoba Agricultural College,
Winnipeg, Man.

Dominion Laboratory of Plant Pathology,
University of Saskatchewan,
Saskatoon, Sask.

Dominion Laboratory of Plant Pathology,
University of Alberta,
Edmonton, Alta.

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